Incident Title	**Lean Amine Tank Explosion**	
Incident Type	Explosion and Fire	
Date	2nd June 2011	
Country	UK (Wales)	
Location	Pembroke (Pembrokeshire)	
Fatalities	**Injuries**	**Cost**
4	1 (life-changing)	Unknown

Incident Description

Credit: UK Health & Safety Executive

The amine regeneration unit (ARU) incorporated 2 identical "breathable" atmospheric storage tanks (17T302/3) which were used interchangeably as a lean amine running tank (reservoir) and a slops separation tank (separator). Both were dosed with a 300 mm (12 in.) deep layer of "diesel" to inhibit oxidation of the aqueous amine solution. An internal sump and siphon drain system and a float and tape level gauge were provided at each tank. The ARU feed surge drum received up to 9 "rich amine" streams containing dissolved or entrained light hydrocarbons. An internal weir enabled liquid hydrocarbons to be skimmed off and passed to the ARU flare knockout (KO) drum. After regeneration, the "lean amine" was pumped from the regenerator to the lean amine running tank and eventually returned to the 9 absorber/contactors across the refinery. The flare KO drum also received light hydrocarbons from other sources. Liquid in the ARU flare KO drum boot was originally pumped to slops, but from 1998 it was pumped to the lean amine running tank instead.

In the days before the incident, the lean amine running tank (17T302) had been taken out of service for cleaning and maintenance. Its amine inventory had been transferred to 17T303, but the "diesel" blanket remained and was now 660 mm (26 in.) deep due to light hydrocarbon contamination. A few days later, while contractors were removing the "diesel" blanket from 17T302 using a vacuum truck, the tank exploded. The resulting overpressure ripped the tank shell away from the floor and ejected the tank roof approx. 55 m (180 ft), where it collided with a pressurised butane storage sphere's support structure. A fireball jetted from the base of 17T302, engulfing 5 workers.

Incident Analysis

Basic cause was ignition of flammable vapour by either electrostatic charge (most likely) or self-heating of pyrophoric material while emptying 17T302.

Critical factors included: 1) The ARU was modified from an open to a closed system (enabling light hydrocarbons to accumulate in the "diesel" layer in 17T302), 2) The operator assigned to empty 17T302 was not familiar with its siphon drain system and did not use the float and tape level gauge to verify it was empty, 3) Flammable vapour was detected in 17T302 headspace 2 days earlier but this was not documented or acted upon by the work planners, 4) The vacuum truck hose was non-conductive and had not been earthed.

Root causes included: 1) Inadequate management of change (flare KO drum boot liquids re-routed to 17T302), 2) Inadequate operating procedure (light hydrocarbon removal from 17T302), 3) Inadequate operator training (sump and siphon drain system), 4) Inadequate communication between workgroups (volatile liquid gushing from inlet/outlet nozzles during isolation, flammable vapour detected in headspace), 5) Inadequate maintenance procedure (tank isolation, cleaning), 6) Inadequate control of work (mitigation of potential ignition sources), 7) Inadequate supervision of contractors.

Lessons Learned

1) A rigorous management of change (MoC) review and risk assessment should be carried out before any changes are implemented on process plant. 2) Companies using contractors should assume the role of "intelligent customer", rather than relying on the contractor's knowledge and experience.

More Information

1) "Chevron Pembroke Amine regeneration unit explosion 2 June 2011", UK Health & Safety Executive, (2020):
2) "Model Code of Safe Practice Part 16: Guidance on Tank Cleaning (Fourth Edition)", Energy Institute (2017), ISBN 978 0 85293 831 6.

Industry Sector	Process Type	Incident Type
Oil & Gas	Amine Regeneration Unit	Explosion & Fire
Equipment Category	**Equipment Class**	**Equipment Type**
Mechanical	Vessel	Atmospheric Storage Tank

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